A Super Cooled, Non-toxic, Non-flammable Phase Change Material Thermal Pack for Portable Life Support Systems, Phase II

Completed Technology Project (2009 - 2011)

Project Introduction

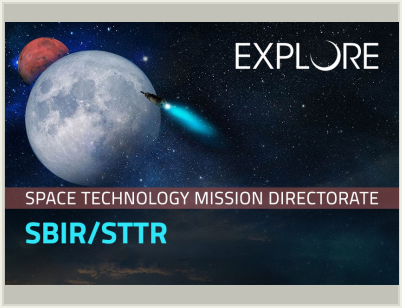
The continuation of concept development and test of a water-based, advanced Phase Change Material (PCM) heat sink is proposed. Utilizing a novel material choice for both an expansion diaphragm and the PCM case itself, the PCM can accommodate both the expansion of the freezing water-based material and very low temperature of approximately -250F. The water-based PCM itself would be non-toxic and non-flammable, but additives will be included to preclude deterioration of wither the PCM container or the diaphragm material. The use of a water-based PCM gives the highest heat capacity for the mass. This is highly limited due to the needs for portability as required for an Extra-Vehicular Activity (EVA). The total heat capacity of an operational unit would be for 4 hour duration EVA use. Through a logical progression of tasks including concept of operation formulation, requirements formulation, concept design reviews and detail design reviews that include design and thermal analysis using Thermal Desktop

TM

models, this effort can progress from the TRL 3 achieved in Phase I to TRL 4-5. The team will continue development by designing a Variable Conductance Interface (VCI) for protecting water in the Liquid Cooling Garment (LCG) from freezing due to the temperature of the heat sink used by the PCM. The team will also develop system improvements identified during Phase I testing. The PCM will be tested to confirm heat input/temperature performance and cycling capability. The test bed will allow for accurate heat input knowledge, temperature monitoring and cycling capability. The results will be compared to the thermal model to ensure accurate prediction capability for the next phase unit and system implementation. The design description and test results would form the basis of the final report.

Anticipated Benefits

Potential NASA Commercial Applications: There are multiple industries within the commercial sector that could use a portable and robust cooling system. In Paragon's experience, our Navy work has exposed us to the critical needs of Navy Seals for underwater cooling during vigorous near-shore ocean operations. Other commercial sectors that may be interested in this technology would be the mining industry, the firefighting equipment industry, the commercial warm-water diving industry, and the chemical/biological hazard suit industry. Each of these has a similar theme of an enclosed person generating substantial metabolic load as well as experiencing environments where the rejection of heat through passive convection and radiation is not possible. Another potential commercial market is on-demand cooling, such as for golf carts which now exhibit cooling on some courses in the hotter parts of the country (see http://www.coolwell.com/). Additionally, hybrid automobiles may benefit from this technology to alleviate the high power demands of the environmental control system.



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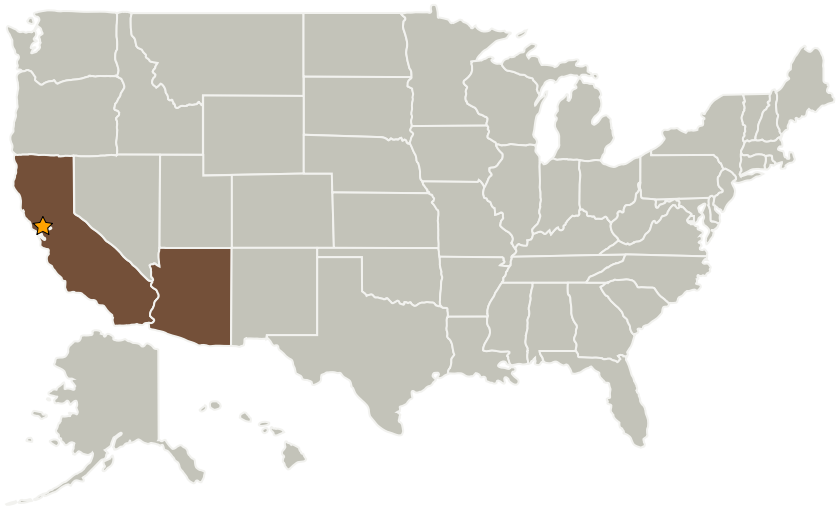
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California
Paragon Space Development Corporation	Supporting Organization	Industry	Tucson, Arizona

Primary U.S. Work Locations	
Arizona	California

Project Transitions

September 2009: Project Start

March 2011: Closed out

Closeout Summary: A Super Cooled, Non-toxic, Non-flammable Phase Change Material Thermal Pack for Portable Life Support Systems, Phase II Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

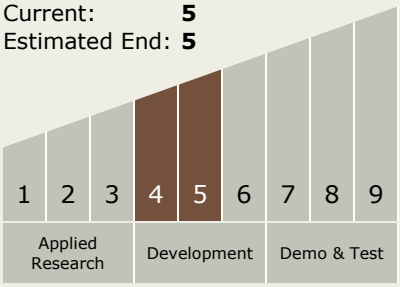
Carlos Torrez

Principal Investigator:

Tom Leimkeuhler

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



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Completed Technology Project (2009 - 2011)

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.3 Sample Handling